

ORGANIC AND APPLIED CHEMISTRY

- (1) (a) Beer or crude ethanol is manufactured by a process called fermentation
- (i) Explain what is meant by the term fermentation
 - (ii) Write equation for the reaction that takes place during fermentation
 - (iii) Is the process of fermentation endothermic or exothermic? Give a reason for your answer
- (b) Describe briefly how in the homes, alcoholic drinks can be prepared from either ripe bananas or millet flour
- (c) Draw a diagram of apparatus that can be used to concentrate the alcohol produced in (b)
- (d) Write equation to show how ethanol can be converted to ethene and indicate the conditions for the reaction.
- (2) (a) A compound Q contains 14.3% hydrogen and the rest being carbon. Calculate the empirical formula of Q
- (b) The relative molecular mass of Q is 28. Determine the molecular formula of Q
- (c) Write equations to show how Q reacts with
- (i) Hydrogen
 - (ii) Bromine water
- (3) (a) Write the structural formula of ethene
- (b) Ethene can be prepared by reacting ethanol with sulphuric acid. State the conditions for the reaction
- (c) (i) State what would be observed when ethene is reacted with bromine
- (ii) Write equation for the reaction
- (4) A hydrocarbon X of formula mass 30, consists of 80% carbon
- (a) Calculate the empirical formula of X
 - (b) Determine the molecular formula of X
 - (c) Write the structural formula of X
- (5) Soap can be prepared by boiling vegetable oil with sodium hydroxide solution and adding a solution of sodium chloride to the reaction mixture
- (a) What name is given to the reaction leading to the formation of soap?
 - (b) Name one crop from which oil for making soap can be obtained
 - (c) Why is sodium chloride added to the reaction mixture?
 - (d) State one advantage and one disadvantage of using detergents instead of soap.
- (6) (a) Name two raw materials used to manufacture soap
- (b) Describe how soap is obtained from the raw materials you have named
- (c) State why detergents are commonly used instead of soap in laundry
- (7) (a) Ethanol can be prepared by fermentation of sugars. Write equation to show how ethanol can be prepared from glucose ($C_6H_{12}O_6$)
- (b) When ethanol is heated with concentrated sulphuric acid at 170°C , a substance W is formed.
- (i) Name W

- (ii) Write equation leading to the formation of W
 - (iii) Write the structural formula of W
 - (iv) Name one reagent that can be used to identify W. State what is observed and write equation for the reaction that takes place
- (8) A compound X consists of 40.0% carbon, 6.7% hydrogen and 53.3% oxygen.
- (a) Calculate the empirical formula of X
 - (b) If the formula mass of X is 60. Determine its molecular formula
 - (c) When a solution of X was added to sodium carbonate, bubbles of a colourless gas were given off
 - (i) State the nature of X
 - (ii) Write the ionic equation for the reaction that took place
- (9) A compound Y consists of 92.31% carbon and 7.69% hydrogen. The formula mass of Y is 26
- (a) Calculate the empirical formula of Y
 - (b) Determine the molecular formula of Y
 - (c) Write the structural formula of Y
- (10) (a) Explain what is meant by the term polymerization
- (b) (i) Name one natural polymer and one synthetic polymer
 - (ii) State one use of each polymer you have named
 - (c) Soap forms scum when mixed with certain types of water.
 - (i) What is the chemical nature of scum?
 - (ii) Outline the physical method used to obtain water free from hardness
 - (iii) Give two advantages of hard water
- (11) (a) (i) State the difference between fats and oils
- (ii) Give one example of each
 - (b) Briefly describe how soap can be prepared
 - (c) State what would be observed if soap solution was shaken with a solution of magnesium hydrogen carbonate
 - (d) Explain your answer
 - (e) State what would be observed if a solution of soapless detergent was used instead of soap solution
 - (f) Give one disadvantage of using soapless detergents
- (12) The molecular mass of gas X is 28 and its empirical formula is CH_2 .
- (a) Determine the molecular formula of X
 - (b) (i) Write the structural formula of X
 - (ii) Write equation for the reaction between X and bromine
 - (c) (i) Name one other reagent that can be used to identify X
 - (ii) State what would be observed if the reagent is used on X
- (13) (a) (i) What is a polymer
- (ii) Distinguish between a natural and an artificial polymer and give two examples in each case.
 - (b) Describe the process of vulcanization of rubber. Your answer should include

- (i) The importance of vulcanization of rubber
 - (ii) The useful items of vulcanized rubber
- (14) Sulphuric acid reacts with ethanol to produce a colourless gas that decolourises bromine water
- (a) Name the gas produced
 - (b) State the conditions for the reaction
 - (c) Write equation for the reaction
 - (d) Give two large scale uses of the gas produced
- (15) (a) Name the ions that cause hardness in water
- (b) Explain how the variation in hardness can be demonstrated in the laboratory
 - (c) State two advantages of hard water.
- (16) (a) Name the raw materials used in your locality to make alcohol
- (b) Briefly describe how the alcohol can be obtained from the raw materials you have named in (a)
 - (c) State how the alcohol you have prepared can be concentrated
 - (d) State one way of determining whether the alcohol is pure or not
 - (e) Ethene can be prepared from ethanol. Write equation and state conditions for the reaction leading to the formation of ethene
 - (f) Name any other two uses of ethanol apart from preparing ethene
- (17) A compound R of molecular mass 42, contains 85.7% carbon and 14.3% hydrogen
- (a) Calculate the empirical formula of R
 - (b) Determine the molecular formula of R
 - (c) Write the structural formula of R
 - (d) To which homologous series does R belong? Give a reason for your answer
 - (e) Briefly describe how R can be identified in the laboratory
 - (f) Give one use of R
- (18) A hydrocarbon Z of molecular mass 56 consists of 85.7% carbon.
- (a) Define the term hydrocarbon
 - (b) Calculate the empirical formula of Z
 - (c) Determine the molecular formula of Z
- (19) During the manufacture of soap, sodium hydroxide solution is boiled with substance X
- (a) Identify substance X
 - (b) What name is given to the process leading to the formation of soap?
 - (c) Name a substance that can be used to precipitate the soap from the solution
 - (d) State what would be observed and write equation for the reaction when soap is reacted with aqueous calcium hydrogen carbonate
- (20) (a) (i) Describe how you would obtain a sample of sugar crystals from sugar cane
- (ii) State two uses of sugar in the world of the sick
- (b) Concentrated sulphuric acid was added to sugar ($C_{12}H_{22}O_{11}$)
- (i) State what was observed

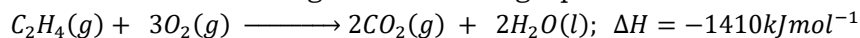
- (ii) What name is given to this process
- (iii) Write equation for the reaction
- (iv) Why is ethanol important to the society
- (c) A mass of 3.10g of an organic compound that contains carbon, hydrogen and oxygen atoms only produced 4.40g of carbon dioxide and 2.70g of water on complete combustion. Calculate the empirical formula of the organic compound
- (21) (a) (i) State one word which means “formation of soap”
- (ii) Name two sources of vegetable oils that can be used to make soap
- (b) Briefly describe how soap can be prepared
- (c) Explain the following
- (i) Water containing calcium hydrogen carbonate will not lather easily with soap unless water has been boiled before using the soap
- (ii) Water containing magnesium sulphate will not lather with soap even after boiling
- (22) (a) Write the molecular formula and the structural formula of ethene
- (b) Bromine water is one of the reagents used to test for the presence of ethene.
- (i) State what is observed during the test
- (ii) Write equation for the reaction that takes place
- (c) Name one other reagent that can be used to test for ethene and state what is observed when the reagent is used
- (d) Name one compound from which ethene can be prepared
- (23) Under suitable laboratory conditions ethene can be converted to a compound with a general formula $(-H_2C - CH_2 -)_n$
- (a) (i) What name is given to the compound $(-H_2C - CH_2 -)_n$
- (ii) What name is given to the change from ethene to $(-H_2C - CH_2 -)_n$
- (iii) Write equation leading to the formation of $(-H_2C - CH_2 -)_n$
- (iv) State one use of $(-H_2C - CH_2 -)_n$
- (b) Name one other compound of the category $(-H_2C - CH_2 -)_n$ which is
- (i) Man made
- (ii) Not man made
- (24) A compound Y of molecular mass 46, consist of 52.2% carbon, 13.0% hydrogen and 34.8% oxygen.
- (a) Calculate the empirical formula of Y
- (b) Determine the molecular formula of Y
- (c) Suggest one possible use of Y
- (26) (a) A compound Q of molecular mass 30 consists of 80.0% carbon and 20.0% hydrogen.
- (i) Calculate the empirical formula of Q
- (ii) Determine the molecular formula of Q
- (iii) Write the structural formula of Q
- (b) The enthalpy of combustion of Q is 84.7kJmol^{-1} . Calculate the enthalpy change when 2.5g of Q is completely burnt in oxygen.

- (27) (a) (i) State the conditions under which sulphuric acid reacts with ethanol
(ii) Write equation for the formation of ethene from ethanol and sulphuric acid
(iii) State the property of sulphuric acid shown in the reaction in (a) (ii) above
- (b) Name one reagent, apart from bromine that can be used to distinguish between ethene and ethane. In each case, state what would be observed in the reagent is separately treated with ethane and ethene.
- (c) A hydrocarbon T, molecular mass 42 contains 85.7% carbon
(i) Calculate the empirical formula of T
(ii) Determine the molecular formula of T
(iii) Write the structure of T
- (d) T was treated with bromine. State what was observed and write the equation for the reaction.
- (28) (a) Write the structural formula of ethene
- (b) (i) Name two compounds that can be used to prepare ethene in the laboratory
(ii) State the conditions for the formation of ethene from the compounds you have named
(iii) Write equation for the reaction that takes place
- (29) (a) State the difference between fats and oils
- (b) Fats and oils can be used to make soap
(i) Define the term soap
(ii) Briefly describe how soap can be prepared
- (c) (i) Name two substances which when present in water can cause permanent hardness of water
(ii) State one chemical method of removing permanent hardness of water
(iii) Write equation for the reaction involved in c(ii)
- (d) Soap was used for washing in hard water
(i) State what was observed
(ii) Write equation for the reaction
- (e) A detergent can be used for washing instead of soap. State one advantage and one disadvantage of using a detergent
- (30) (a) A compound Y contains 52.17% carbon, 13.04% hydrogen and 34.78% oxygen. The molecular mass of Y is 46. Determine the
(i) Empirical formula of Y
(ii) Molecular formula of Y
- (b) When Y was heated with excess concentrated sulphuric acid, a colourless gas Z which turned bromine water colourless was evolved. Identify
(i) Y
(ii) Z
- (31) The molecular formulae of organic compounds J and M are C_3H_6 and C_3H_8 respectively.
(a) Write the structural formulae and name of J and M
(b) Name one reagent that can be used to distinguish between J and M
(c) State what is observed in each case when the reagent used

- (32) (a) Alkenes and alkanes are hydrocarbons
 (i) Define the term hydrocarbon
 (ii) State the structural difference between alkanes and alkenes
 (b) The boiling point of straight chain alkanes having two to seven carbon atoms are shown in the table below.

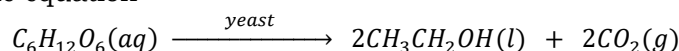
Number of carbon atoms	2	3	5	6	7
Boiling point (°C)	-79	-42	37	69	98

- (i) Plot a graph of boiling point against number of carbon atoms
 (ii) From the graph, determine the boiling point of the alkane with four carbon atoms
 (c) (i) What is the shape of the graph
 (ii) State the relationship between the boiling point of the alkane and the number of carbon atoms in the alkane
 (d) (i) Name one reagent other than bromine that can be used to distinguish between ethane and ethene
 (ii) State what would be observed if the reagent you have named above was separately treated with ethane and ethene
 (e) Ethene burns in air according to the following equation

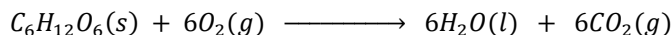


Calculate the amount of heat evolved when 12.5g of ethene is completely burnt

- (34) Using a suitable yeast, glucose can be converted to ethanol and carbon dioxide according to the equation

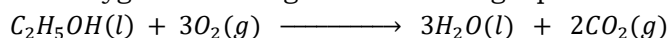


- (a) Name the
 (i) Process taking place
 (ii) Enzyme in yeast that converts glucose to ethanol
 (b) Glucose also produces carbon dioxide when burnt in air according to the equation



Calculate the mass of glucose that when burnt would produce 1.2dm³ of carbon dioxide at room temperature

- (35) (a) Glucose, $C_6H_{12}O_6$, in the presence of an enzyme undergoes fermentation to form ethanol
 (i) Write equation for the fermentation of glucose
 (ii) Name the enzyme that causes fermentation
 (b) Briefly describe how ethanol can be converted to ethene
 (c) Ethanol burns in oxygen according to the following equation



When 15.70g of ethanol was completely burnt in oxygen, 466.5kJ of heat was produced. Calculate the molar heat of combustion of ethanol

- (36) A compound Q of formula mass 60 contains 40.0% carbon, 6.7% hydrogen and the rest being oxygen.
- Calculate the empirical formula of Q
 - Determine the molecular formula of Q
 - Q dissolves in sodium hydrogen carbonate with effervescence
 - Suggest the chemical nature of Q
 - Write an ionic equation for the reaction between Q and aqueous sodium hydrogen carbonate
- (37) (a) Write the structural formula of
- Ethene
 - Ethane
- (b) Name one reagent that can be used to distinguish between ethene and ethane
- (c) State what is observed in each case when the reagent is used and write equation for any reaction that takes place.
- (d) Write equation for the polymerization of ethene.
- (38) The general formula of compounds Q and R are C_nH_{2n} and C_nH_{2n+2} respectively
- Write the molecular formula and the name of Q and R for $n = 2$.
 - State the structural difference between Q and R
 - Name a reagent that can be used to distinguish between Q and R
 - State what is observed if the reagent you have named is separately treated with Q and R
 - Write equation for any reaction that would take place in c(ii)
- (39) (a) Natural rubber is soft and it is normally made hard before use
- Name the process by which natural rubber is made hard
 - State how natural rubber is made hard by the process you have named in a(i)
- (b) State
- Two reasons why natural rubber is made hard before use
 - Two uses of rubber
- (40) (a) State the difference between the following pairs of terms
- Synthetic polymer and natural polymer
 - Thermosetting polymer and thermosoftening polymer
- (b) (i) State the conditions under which sulphuric acid can react with ethanol to produce ethene
- (ii) Write equation for the reaction leading to the formation of ethene
- (c) When reacted together, ethene molecules can form a polymer
- Name the polymer
 - Write equation leading to the formation of the polymer
 - State one use of the polymer
- (d) Name one
- Synthetic polymer other than the one you named in (c) (i)
 - Natural polymer other than rubber
- (e) State one
- Use of each polymer you have named in (d) (i)

- (ii) Disadvantage of the polymer formed in (c) (ii)
- (41) The molecular formula of an organic compound J is C_3H_8
- Write the structural formula of J
 - Name J
 - Name the group of organic compound to which J belongs
- (b) It is not wise to burn J in a living room with closed windows and doors. Give a reason
- (c) State one use of J
- (42) (a) Describe how pure sugar can be obtained from sugar cane on industrial scale
- (b) Sugar can be converted in the presence of an enzyme to ethanol. Name the
- Process leading to the formation of ethanol
 - Enzyme used in the process
- (c) Write an equation for the reaction that leads to the formation of ethanol
- (d) When concentrated sulphuric acid was added to sugar, a black solid was formed. Explain what took place.
- (e) State one use of
- Sugar
 - Ethanol
- (43) A gaseous organic compound J contains 82.76% carbon and the rest being hydrogen.
- To which group of organic compounds does J belong
 - Calculate the empirical formula of J
 - 140cm^3 of J weighed 0.363g at s.t.p. Determine the molecular formula of J (1 mole of J occupies 22400 cm^3 at s.t.p.)
- (44) (a) (i) Name one process by which ethanol can be produced from sugar
- (ii) Write equation for the production of ethanol by the process you have named
- (b) Ethanol can be converted to ethene by dehydration
- Name the dehydrating agent
 - State the conditions under which the reaction takes place
 - Write equation for the reaction leading to the formation of ethene from ethanol
- (c) Write equation for the reaction between ethene and bromine.
- (45) Under suitable laboratory conditions, ethene can be converted to ethane
- State the condition necessary for this conversion
 - Write equation for the reaction that takes place
 - Write the molecular and structural formula of ethane
 - Write equation for the combustion of ethane in
 - Limited oxygen
 - Excess oxygen
- (46) Ethene is classified as an alkene and can be prepared in the laboratory by dehydration of ethanol
- (a) (i) State what is meant by the term alkene

- (ii) Write the structural formula of ethane
 - (iii) Name the reagent which is used as the dehydrating agent in the preparation of ethane
- (b) Bromine was added to ethene
- (i) State what was observed
 - (ii) Write equation for the reaction
 - (iii) State the application of this reaction
- (c) Under high temperature and pressure, ethene molecules can react with one another to form a big molecule **Z**
- (i) Name molecule **Z**
 - (ii) State one use of **Z**
- (47) The molecular formula of organic compounds X and Y are C_3H_6 and C_3H_8 respectively
- (a) Write the group to which each belongs, structural formula and name of each compound

Compound	Group	Structural formulae	Name
X			
Y			

- (b) Name one reagent that can be used to distinguish between X and Y
- (c) State what would be observed if the reagent you have named in (b) was treated with
- (i) X
 - (ii) Y
- (d) Give one use of each of the compounds
- (i) X
 - (ii) Z